

Ohio Creek Watershed Transformation

A large focus of the proposed activities within the Ohio Creek Watershed is to protect residential housing from nuisance flooding and future coastal inundation. During Hurricane Irene, coastal storm surge pushed up the Elizabeth River and into the few remaining low-lying areas that were the original Ohio Creek, and from there, the water slowly inundated the neighborhood. When there are hurricanes, nor'easters, and even during high tides, water from the Elizabeth River also moves backward up the stormwater drainage system and consequently prevents rainfall from draining out of the neighborhood. During especially high surges, the water from the river can back up the system far enough to flow out onto streets and sidewalks.

Even when the river is experiencing normal tide conditions, the outdated stormwater system is too small to convey run-off to the river during many rainfall events. As a consequence, the neighborhood streets and sidewalks flood frequently. There are only two roadways from which residents can enter and leave the neighborhood—one of which is submerged during nuisance flood events. As a result, the residents are cut off from the rest of the city.

To remedy this situation, three water-management tactics are proposed. First, protect the shoreline so that high water levels in the river do not enter the neighborhood or the stormwater system. Second, capture rainfall across the watershed to slow its flow into the stormwater system and provide additional storage for rainwater so that the water does not pond in the streets. Third, introduce a living shoreline feature to minimize erosion and increase environmental wellness. Moreover, the City of Norfolk proposes to use these water-management activities as opportunities to improve the neighborhood by increasing neighborhood connectivity, adding new and improved natural habitat, and increasing resilience to future flooding.



Figure II.4 Ohio Creek Watershed Vision Plan

Shoreline Protection

The 100-year coastal surge along this part of the Elizabeth River is approximately 8 feet at present day sea levels. However, according to the National Oceanic and Atmospheric Administration's (NOAA's) intermediate SLR forecast, the combined effects of SLR and subsidence may amount to as much as a 2.5-foot increase over the next 50 years. In order to provide a resilient defense against future surge and waves, coastal protection should be based upon a 100-year coastal surge of 11 feet.

To ameliorate the most significant vulnerability for the communities in this watershed, Kimble Terrace Drive will be elevated from its current elevation to 11 feet, and a new, higher bridge will be constructed. This road raising serves two functions; the first is to prevent water from flowing over the road and into the upland area, and the second is to maintain passable and safe egress in and out of the adjacent neighborhoods during times of high tide and coastal flooding.

To further mitigate vulnerability to coastal flooding, the two drainage outfalls under Kimball Terrace (west of Chesterfield Heights) will be fitted with tide gates that can be closed during high water conditions in the Elizabeth River. Additionally, a series of smaller tide control devices will be installed along the shoreline of the neighborhood in the lower lying areas. This will prevent coastal surge from flowing into the marsh areas and inundating the neighborhood as happened during Hurricane Irene.

To increase resilience to future coastal flood events, a shoreline protection system will stretch from Kimball Terrace Drive on the west of Chesterfield Heights to the east side of the Grandy Village, and inland along the eastern perimeter of the Grandy Village neighborhood. The berm and wall system only needs to be 2 to 3 feet above prevailing grade in order to provide protection against the future 100-year coastal flood. The berm is envisioned to contain a robust sheet pile core with an exterior of soil, which will be vegetated with grasses and indigenous plants. If desired by the community, a walking path of pervious pavement, exercise equipment, benches, and picnic tables can be placed on the river front berm to provide a recreational amenity. In this way, the flood-protection feature will be visually integrated into the existing landscape. Though a flood-protection berm is preferred in the design, several locations along the river front have inadequate space to provide a properly sloped berm due to existing infrastructure. In these areas a vertical flood wall is proposed on the river side with a graded landscape feature on the inland side.

A robust living shoreline will be created. The slope of the berm and the elevation of the rock breakwater and vegetation of the shoreline construction will be carefully integrated so that as sea levels rise, the natural vegetation will be able to adapt by moving up the properly graded river bank. This presence of the rock, soil, and vegetation will function to attenuate wave energy and prevent erosion of the shoreline during coastal flooding events. In this way, the combined, multiple layers of defense from the berm and the living shoreline, will afford greater protection in concert than either feature could provide by itself. In addition to contributing to the robustness of the shoreline flood protection system, the marsh vegetation will provide important habitat along this reach of the river that will benefit local faunae and recreational fishing, which is popular in the community.

Finally, to seal off the perimeter of the watershed, several roadway portions on the northeast side of Grandy Village will be raised to an elevation of 11 feet so that coastal surge cannot enter the neighborhood overland from the east. Though these elevations are relatively minor adjustments to the perimeter topography and landscape, the neighborhood can be made significantly more resilient to both

present and future 100-year coastal flooding, critical access to the neighborhood can be maintained during times of emergency, and approximately 450 low to moderate income homes will be kept out of harm's way.

Summary of Shoreline Protection

- Length of Elevated Roads: 3,000 linear feet
- Length of Coastal Berm: 5,000 linear feet
- Length of Flood Wall: 2,100 linear feet
- Number of Tide Control Devices: 8 devices at 5 locations
- Structures protected from 100-year coastal flooding: 477 structures

Innovative Stormwater Management

By nature of preventing coastal surge and high tides from backing up the stormwater system, the shoreline protection described above will provide significant improvement of the ability for the system to drain during low-intensity rain events. However, the very Old stormwater infrastructure remains significantly undersized, with much smaller diameter pipes than would be used today. The small pipes limit the capacity to convey large water volumes from the intense summer thunderstorms that can cause nuisance flooding. Nuisance flooding can be reduced by capturing and slowing down the water infiltration into the storm system, thereby alleviating any potential backflow or overload. To further mitigate the vulnerability to street and neighborhood flooding, several tactics are proposed to attenuate the intensity of stormwater runoff within the neighborhood.

Flooding can be reduced by capturing and temporarily retaining water in barrels, rain gardens, open areas, and parks. The City of Norfolk proposes to implement a dispersed stormwater-collection program using a combination of rain barrels and rain gardens at each residential parcel within the watershed. The flow in roof gutters and downspouts will be redirected into a storage device that has a capacity to accommodate the 10-year rainfall volume and discharge it slowly from an outlet on the bottom of the device. When each parcel temporarily stores the water that falls on their own property and releases it slowly into the communal drainage, the initial pulse of stormwater into the system is attenuated, which helps to prevent the undersized system from being overwhelmed and backing up into the streets.

As part of the stormwater-collection program and in order to bring about a community-wide sense of responsibility for personal environmental impacts, the City intends to encourage all residents of the watershed to participate by offering discounted city fees to the participants. This program incorporates, builds upon, and refines community-chosen designs that have been developed and engineered by Hampton University, Old Dominion University, and Wetlands Watch. Public outreach and education materials and events about stormwater, flooding, and water quality will be offered, building upon and incorporating best strategies and lessons learned from the successful and innovative Elizabeth River Project: River Stars Program.

Stormwater flooding is also mitigated by reducing the amount of impervious surfaces in the neighborhood so that rainfall can infiltrate into the soil rather than entering the stormwater-drainage system. The City proposes to retrofit existing streets with pervious pavement, bio-swales, and rain gardens to manage stormwater collection in parts of the neighborhood. Many of the neighborhood streets have street parking along one or both sides of the street, which is currently impervious material.

The City proposes to replace the impervious paving with permeable pavement under all of the parking areas to allow infiltration along the street curbs. In addition, at many street intersections, "green"

decorative planters will be constructed in the sidewalks that contain flowers and ornamental plants but will also contain water-storage capacity. Finally, a large box culvert will be placed underneath Marlboro Avenue in the watershed to receive water from the uphill surface streets and release it much more slowly into the existing stormwater system.

In addition to the innovative parcel scale and street-level stormwater detention, the proposed project includes increased capacity and improvement of several large stormwater-retention areas, which will simultaneously increase wetland habitat. Several marsh retention areas on the western side of the watershed are expected to provide a total of 1.7 million cubic feet of rainwater storage, and will be connected to and integrated with the wetlands and park areas in the design for a holistic stormwater management and treatment system.

The passage of stormwater through the wetlands will remove phosphorus and nitrogen, thereby helping the city to meet its TMDL targets. Finally, there are several parcels imperiled by low elevation and proximity to flooded areas. The City proposes to acquire these properties and turn them into multi-purposed open park space and recreational amenities where residents can gather during dry days, but where additional stormwater will be detained during rainfall events. Figure 11.7 indicates new park and green spaces to be added to the area. The sum of parcel scale, street scale, and large-scale detention will be adequate to accommodate the 10-year rainfall and prevent most nuisance flooding of streets, sidewalks, and homes.

Because tidal gates and check valves will block the discharge of stormwater during coastal flooding and high tide, stormwater will be stored inside the berm in the marsh areas. Despite the increased capacity of stormwater retention, the storage is limited. For many rain events, the stormwater will exceed the storage capacity of the system before the river stage subsides and the gates can be opened to release the stormwater into the river. Thus, several large pumps are proposed to discharge rainwater over the coastal berm and into the river. These pumps help to ensure that the rainfall within the Ohio Creek Watershed can be adequately managed.

Summary of Stormwater Management

- Total Area of City-Installed Rain Gardens: 7,200 square feet
- Estimated Area of Pervious Street Paving and Walkways: 13,000 linear feet
- Storage Capacity of Green Streetscape and Box Culvert: 36,000 cubic feet
- Number of Newly Installed Pumping Stations: 5 stations
- Protected and Enhanced Wetlands: 15.1 acres

Community Amenities

All of these strategies offer the advantage of a small-scale, replicable, and community-oriented approach to resiliency at a neighborhood scale. The communities of Chesterfield Heights and Grandy Village contain school facilities and a community center. As neighborhood streets are improved with green stormwater techniques, new permeable bicycle and sidewalk connections will be constructed, providing recreational benefits as well as safe routes to school and other community facilities. Bike lanes and new pedestrian walkways are designed in the proposed project, which will increase neighborhood connectivity and help improve social cohesion. Additionally, improvements will be made at the Campostella Road Intersection will help integrate the Ohio Creek Watershed communities into the surrounding urban fabric.

Along the waterfront, the berm can be utilized as community open space with a promenade as a central feature. Along the promenade, benches, picnic tables, and exercise stations provide additional public benefit. Further multi-purpose open space and recreational amenities will be provided with the acquisition of several parcels imperiled by low elevation and proximity to flooded areas.

Summary of Community Amenities

- Length of permeable walkways: 13,000 linear feet
- Wetlands increased and protected: 15.1 acres
- Newly Developed Sports Fields: 2.9 acres
- Added Waterfront Park Space: 11.5 acres
- Newly Planted Trees: 478 trees

Elizabeth River Shoreline Restoration

As part of the proposed activities in the Coastal Adaptation and Community Transformation Plan, the City of Norfolk will construct robust living shorelines (also known as constructed wetlands) along the banks of the Elizabeth River in portions of the Target Area.

Living shorelines are placed parallel to the shore, from upland to the river, and create habitat for species, safeguard the shoreline from erosion due to wave energy, soak up stormwater and reduce storm surge, and trap polluted runoff, slowing the flow of nutrients, sediment, and chemical contaminants into rivers, streams, and the Chesapeake Bay. When combined with the shoreline berm, a robust living shoreline can increase durability and effectiveness of the flood protection structure. For design details, see the Elizabeth River Shoreline Restoration Project section. Length of Living Shoreline Improvements: 2,200 linear feet

Grandy Village Phase VI NRHA Activities (Leverage)

The Grandy Village Phase VI activity being undertaken by the Norfolk Redevelopment & Housing Authority (NRHA) is part of Norfolk's commitment to the Ohio Creek Watershed. Construction is anticipated to begin May 2016. Changes to Grandy Village involve the demolition of older public housing units and the construction of 70 new apartments, a 1,500-square-foot community office, associated infrastructure, and a new roadway for the entire community connecting Kimball Terrace and Wiley Drive, as well as stormwater measures (e.g., expansion of bio-retention area and manufactured water quality inlets, grass swales) and open spaces.

The residential units will be spread across 12 new buildings totaling 88,982 square feet, featuring a mix of Garden and Townhouse styles ranging from 1 to 4 bedrooms. The 70 units will replace obsolete units built in the early 1950's that lacked central heat and air conditioning, as well as other standard amenities that are common in apartments today (e.g., dish washers, hook ups for washers and dryers, energy-efficient appliances and more spacious apartments).

The NRHA will integrate these properties into the surrounding neighborhoods, using landscape plantings and amenities—such as playgrounds, playing field space, and proper lighting—to enhance the quality of residents' lives.

The Grandy Phase VI project will integrate similar features, such as residential units overlooking the Elizabeth River to the south of the property. Landscape design includes the provision of grading and

stormwater conveyance away from buildings; sod, seeding and planting beds in all disturbed areas; buffer yards; streetscape; parking; and foundation plantings. Existing wetlands and tidal areas on the property will be preserved or enhanced. Water conservation practices will be achieved through drought tolerant plantings and limited irrigation. Outdoor common areas for the residents will be located at the center of the main project area.

An open field (approximately 41,000 square feet) of usable gathering and play space is allocated for this amenity. The gathering area will be sited centrally, with residential units surrounding the space. Adjacent to the gathering space, a playground will be constructed to the southeast, easily accessible by the residents via proposed sidewalk connections. Proposed sidewalks also tie into the existing neighborhood sidewalks that branch out to the city sidewalks and nearby commercial centers. It is intended that this developer would work with private investors that will be further incentivized by the work herein proposed to build in the target areas in alignment with the desired future outcomes of Norfolk.